

REMARKS

The present application has been carefully studied and amended in view of the outstanding Office Action dated January 9, 2009, and reconsideration of that Action is requested in view of the following comments.

A petition for a three-month extension of time accompanies this response together with the appropriate fee. A request for continued examination has also been filed.

Independent claim 1 is directed to an injection molding comprising polyacetal. Injection molding is the only practical way to form these moldings. The molding of claim 1 has a difference between the minimum and maximum wall thicknesses of at least about 3 mm. The molding also includes a microcellular structure that includes cells formed by the spontaneous escape of gas due to a reduction in temperature and/or pressure below the temperature and/or pressure critical point of a supercritical fluid dissolved in a polymer melt form which the molding is formed. At least 70% of the cells are spherical with a diameter from 1 to 100 μm . The mechanical properties and/or chemicals resistance of the molding is/are better than that/those of a corresponding solid molding. Claim 1 now incorporates the density of the molding recited in claim 5 (10% to 25% less than the density of a corresponding solid molding). The subject matter of previously presented claim 7 is incorporated into claim 1. Claims, 5 and 7 are canceled. The average cell size of 5- 50 μm is recited.

By way of background, the present invention is practiced by the incorporation of super critical (SC) fluids. This is different than the use of a blowing agent. The key feature in the use of SC-fluid is spherical, micron-sized pores.

As explained in the specification on page 10 line 30:

It is preferable that, based on the total weight of the resultant mixture, up to 30% by weight, preferably from 10-8 to 5% by weight, in particular from 10-4 to 2% by weight, particularly preferably from 0.01 to 1% by weight, of a fluid in supercritical state is added to the melt encompassing polyacetal. The fluid and the polymer melt are, if appropriate, sheared and mixed by well-known processes, e.g. in an extruder or kneader, whereupon the fluid becomes dissolved in the polymer melt.

In one particular embodiment of the present invention, the amount selected of the fluid may be such that the viscosity of the solution of the fluid in the polymer melt is up to 60% below the viscosity of the pure polymer melt. These viscosity values may be regulated, inter alia, via the amount of the fluid.

Further as noted on page 12, lines 7-10:

Among the preferred substances which may serve as fluid are carbon dioxide (CO₂), nitrogen, dinitrogen monoxide, ethylene, propane, and ammonia, but preference is given to atmospheric gases, in particular carbon dioxide and nitrogen.

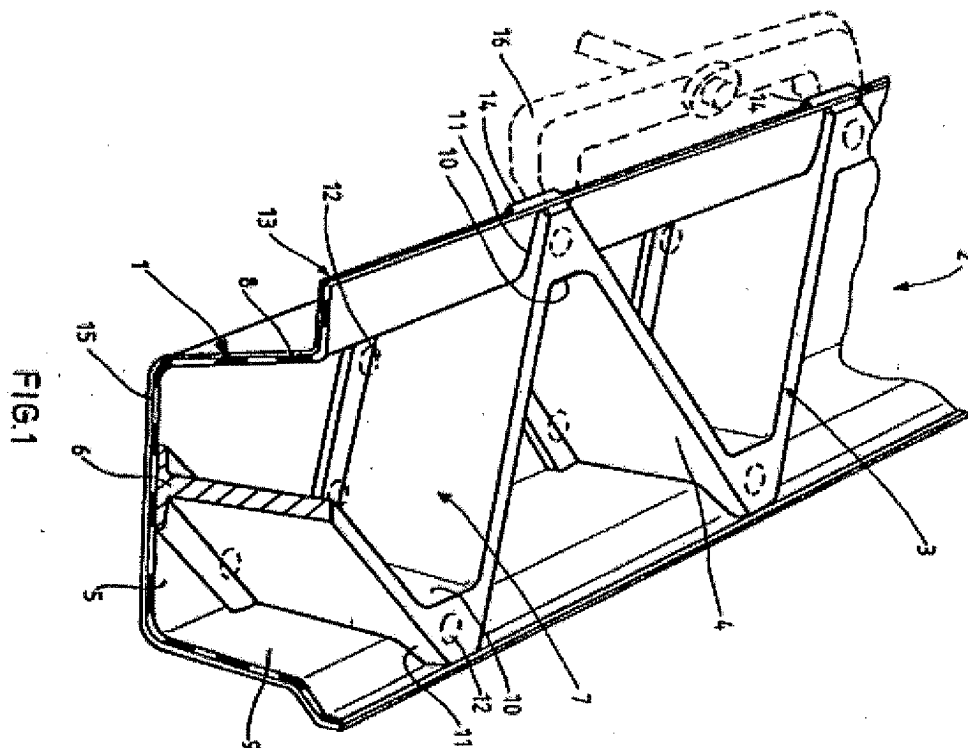
Also, at page 12, line 23 – page 13, line 3:

In order that supercritical gases can be handled within injection molding technology, particular machine technology is needed. At first the plastics pellets are melted, as usual in customary injection molding. In the cylinder of the injection molding machine, the supercritical gases are then introduced into the thermoplastic melt. In order to keep the pressure within the cylinder stable - i.e. prevent premature escape of the supercritical gas - the cylinder has to be gas-tight. The mixture composed of melt and supercritical gas is then injected at high speed and high pressure into the mold. The molds and machines are known and are described by way of example in WO 00/73036 and WO 00/59702.

Claim Rejections – 35 U.S.C. § 103

In the Office Action, claims 1 and 3-15 were rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent App. Pub. 2001/0036559 to Haack in view of European Patent App. No. 0370342 to Goldbach and further in view of United Kingdom Patent No. 1,104,467 to Celanese. Haack discloses a metal-plastic composite made

from fiber-reinforced thermoplastics. Among a long list of possible plastic materials, Haack discloses that polyacetal may be utilized as the thermoplastic. Goldbach discloses a structural shell with reinforcing ribs. Fig. 1 of Goldbach is illustrated below:



As illustrated, the reinforcing ribs 3 are attached to the shell 1 with a widened foot 6. Celanese discloses cellular polyoxymethylene. The cells are formed in the mold by the degradation of the polyoxymethylene to formaldehyde or by utilizing a blowing agent.

Previously, independent claim 1 required wall thickness differences in the molding. Claim 1 has presently been amended to require that the difference between the minimum and maximum thickness is at least about 3 mm. The Office Action cites Fig. 1 of Goldbach (illustrated above) as allegedly disclosing wall thickness differences. As disclosed by Applicants, differences in wall thickness normally deteriorate the mechanical and, particularly, chemical resistance properties. For instance, when

comparative example 1 was subjected to 50% sulfuric acid for 5 minutes, “cracks immediately appeared at wall-thickness differences.” pg. 14, lines 13-14. In contrast, the ribs of Goldbach merely have a “widened foot” (6) to create an enlarged contact surface to increase adhesion of the ribs (3) to the shell (1) and assist in absorption of shear forces to prevent debonding of the ribs from the shell. Thus, contrary to that asserted in the Office Action, Goldbach fails to disclose wall thickness differences as required for Applicant’s claimed moldings. Furthermore, Goldbach fails to disclose any wall thickness measurements. As such, one skilled in the art would certainly not glean any advantage or suggestion to create a molding that requires a difference of at least about 3 mm as required by Applicant’s claim 1.

Furthermore, the Office Action cites Celanese as providing a teaching of Applicant’s claimed microcellular structure. Applicant has amended claim 1 to require the microcellular structure to comprise cells formed by the spontaneous escape of gas due to a reduction in temperature and/or pressure below the temperature and/or pressure critical point of a supercritical fluid dissolved in a polymer melt from which the molding is formed. At least 70% of the cells are spherical and comprise a diameter from 1 to 100 μm .

The microcellular structure of Celanese is formed by utilizing portions of polyoxymethylene in which the end groups have not been stabilized. Thus, the polyoxymethylene decomposes and releases formaldehyde. First, Applicant’s respectfully submit that one skilled in the art would not look to Celanese and glean it obvious to construct the product of Applicant’s claim 1. Indeed, one skilled in the art appreciates that decomposition of the primary component of the molding (e.g., see

Applicant's claims 3 and 24) does not advance Applicant's objective to construct a molding with superior mechanical and chemical resistance properties (in addition to claim 1, see also, claims 6-8).

Conventional molding techniques are taught by Haack as suggested at paragraph 0020. This does not encompass the direct injection of SC-fluid in the molding cycle.

Nothing is provided to enable one of ordinary skill to directly injection mold a SC-fluid containing polyacetal material. Goldbach on the hand merely teaches metal-plastic composites but nothing as to microcellular structures. Goldbach is also non-enabling for methods to make microcellular injection moldings.

Celanese does not have a "similar pore size" now recited as 5- 50 microns taken together with the density reduction of 5 to 30%, as now claimed. Celanese is also non-enabling for forming a molding by the direct injection molding by injecting SC-fluid. Also, Celanese teaches any and all methods to form foam except the direct injection molding using SC-fluid. Other methods taught include degrading the polymer to liberate formaldehyde or chemical blowing agents.

This degrades the resulting properties and does not result in the same level of pore size control and limited density reduction, and does not necessarily result in the improvement of properties, rather likely a loss of properties.

In the working examples of Celanese, foamed polyacetal was not firstly injection molded. Foam was formed using a chemical blowing agent, or by injection of nitrogen followed by pouring into cooling trays to form slab stock. See example 4. Example 3 shows a method of degrading an unstabilized polymer. Moreover, the broad range of

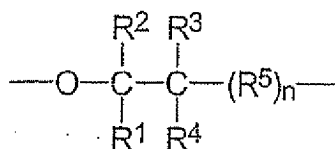
cell structure taught being from 5-80% does not enable the skilled person to direct injection molding of microcellular polyacetal, and does not lead to the motivation to expect a surprising effect of improved screw insertion while weight is reduced.

From the above description of Haack, Golbach and Celanese, these are nonenabling for an injection molding process forming the claimed injection molding. Independent claim 1 requires a supercritical fluid to form the specified microcellular features. None of the references teach any method to form these. Such limitations being nonenabled can not form the basis for applying the standards of obviousness. The supercritical fluid assists to form a majority of spherical cells (i.e. at least 70% as claimed in claim 1) and allows the formation of a structure in which the cells are generally uniformly distributed (see claim 28). One skilled in the art appreciates that spherical cells and generally uniform distribution are not readily obtained from random decomposition of the polyacetal to formaldehyde or the simple injection of a gas into the polymer (i.e. blowing agent).

Furthermore, independent claim 1, as amended requires the density of the molding to be limited to 5% to 30% reduction over the density of a corresponding solid molding. First, none of the references disclose or fairly suggests such a limitation. Second, regarding Celanese, one skilled in the art appreciates that such a drop in density would require a large portion of polyoxymethylene to decompose to formaldehyde. Such decomposition would likely render the molding nonfunctional or, at least, create a molding with detrimental effects to the mechanical and/or chemical resistance properties. Furthermore, Applicant's note that Celanese discloses at least some terminal stabilization of the polyoxymethylene and the addition of chemical

stabilizers. Applicant respectfully submits that degradation of the polyoxymethylene to produce enough formaldehyde to reduce the density of the molding 5% to 30% may not even be possible as there may not be enough formaldehyde capable of being produced. At the very least, such a reduction in density is neither obvious nor inherently disclosed by Celanese (nonenabled) nor provided any of the other cited references.

Furthermore, the application presently includes new claims 21-28 that Applicant respectfully submits further define over the cited references. For instance, claim 21 requires the molding to comprise a flow path length, the ratio of the flow path length to the wall thickness difference being from 1:1 to 500:1. Claim 22 requires the polyacetal to include 0.1 to 20 mol% of repeat units of the general formula



Claim 23 requires polyacetal with a number-average molecular weight of from 10,000 to 100,000 and a volume flow index from 1 to 70 cm³/10 min. Claim 24 requires a molding composition with at least 95% by weight of polyacetals. Claim 25 requires the supercritical fluid present in the polymer melt from 10⁻⁸ to 5% by weight. Claim 26 requires the supercritical fluid to be selected from the group consisting of carbon dioxide, nitrogen, dinitrogen monoxide, ethylene, propane, ammonia, and combinations thereof. Claim 27 requires the supercritical fluid to reduce the polymer melt viscosity up to 60% below the viscosity of the pure polymer melt. Claim 28 requires the cells to be generally uniformly distributed within the molding. Applicant respectfully submits that

the cited references fail to disclose or fairly suggest any of the limitations noted above present in new claims 21-28.

Thus, for at least the reasons noted above, the above-cited references fail to disclose or fairly suggest one or more limitations of the present claims. Additionally, for at least the reasons noted above with respect to independent claim 1, dependent claims 3, 4, 6-14, and 21-28 are also patentable over the cited references. However, the patentability of the dependent claims do not hinge on the patentability of claim 1.

Accordingly, for these reasons it is believed that the pending claims are directed to patentable subject matter, and notice to that affect is respectfully requested.

Respectfully submitted,

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